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# **Emission trends of anthropogenic air pollutants in the northern hemisphere**

# Methodology



## IIASA's RAINS (Europe+Asia) model:

- National energy projections up to 2020
- + national legislation on air pollution control
- = **national emission projections, control costs**
  
- + atmospheric dispersion
- + impact assessment
- = **regional environmental impacts of ozone, acidification, PM**

# Emission legislation (1)



## **Europe:**

1999 Gothenburg Protocol of CLTRAP

EU legislation: National Emission Ceilings Directive  
(2000)

## **Former Soviet Union (FSU):**

Action implied by Gothenburg Protocol for European part of Russia

## **North America (US + Canada):**

US Clear Skies Initiative

Ozone Annex of Canada-U.S. Air Quality Agreement

## Emission legislation (2)



**China:**

10<sup>th</sup> Environmental 5-years Plan 2000-2005

**East Asia (Japan, Korea, Thailand, Indonesia, Philippines, etc.):**

Review of national legislations

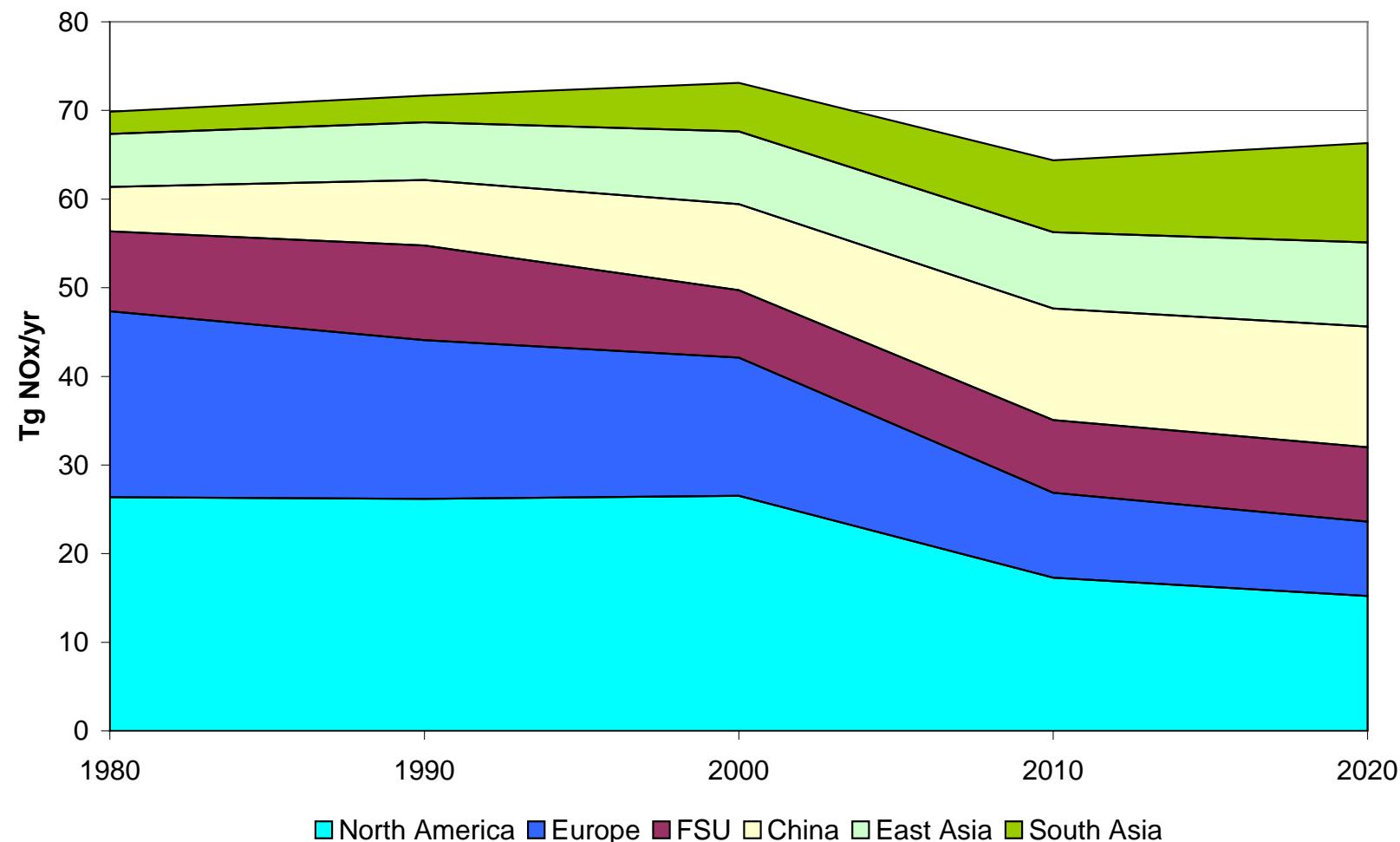
**South Asia (India):**

Essentially uncontrolled

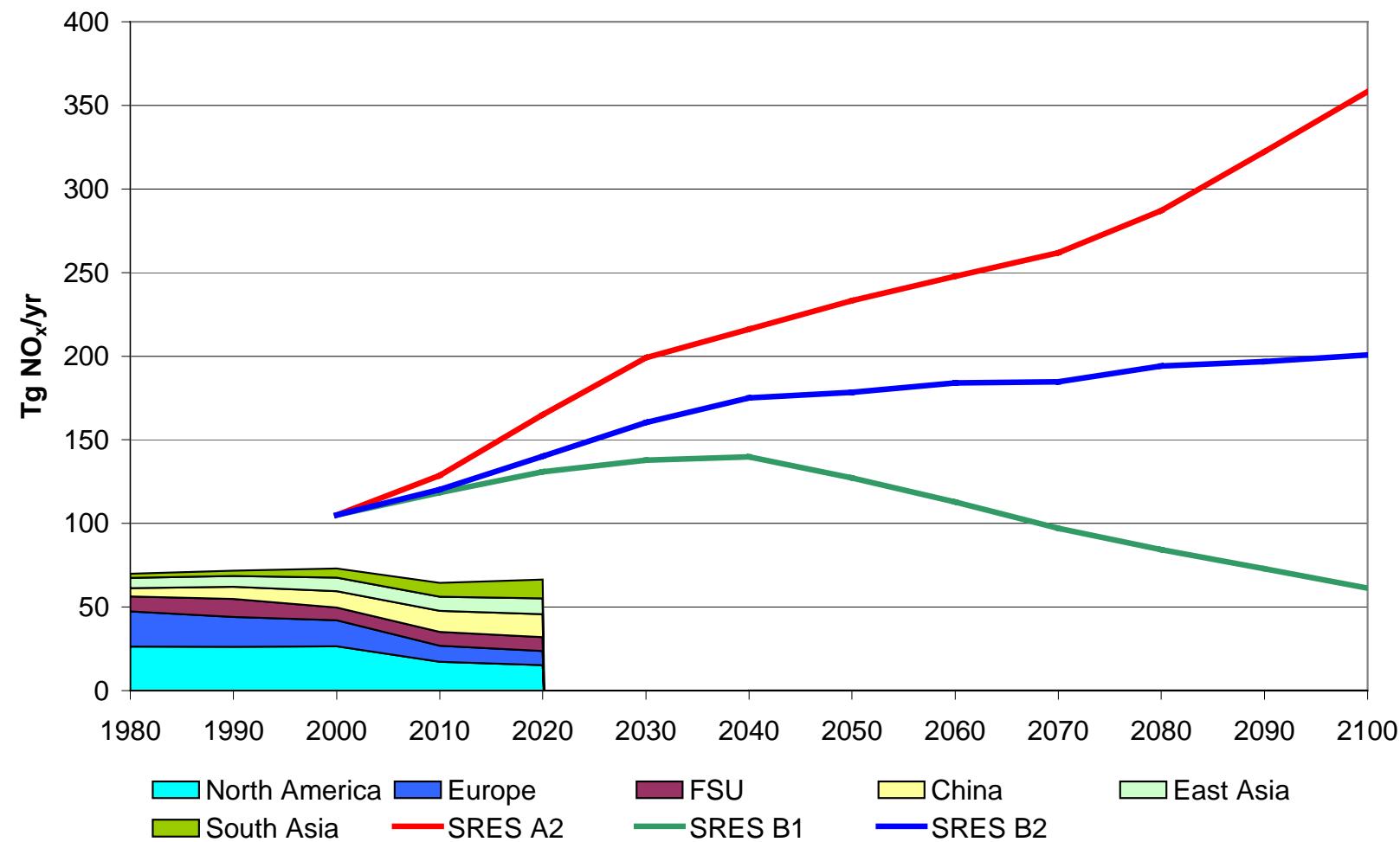
**Mexico, Middle East, North Africa:**

Not included in this analysis

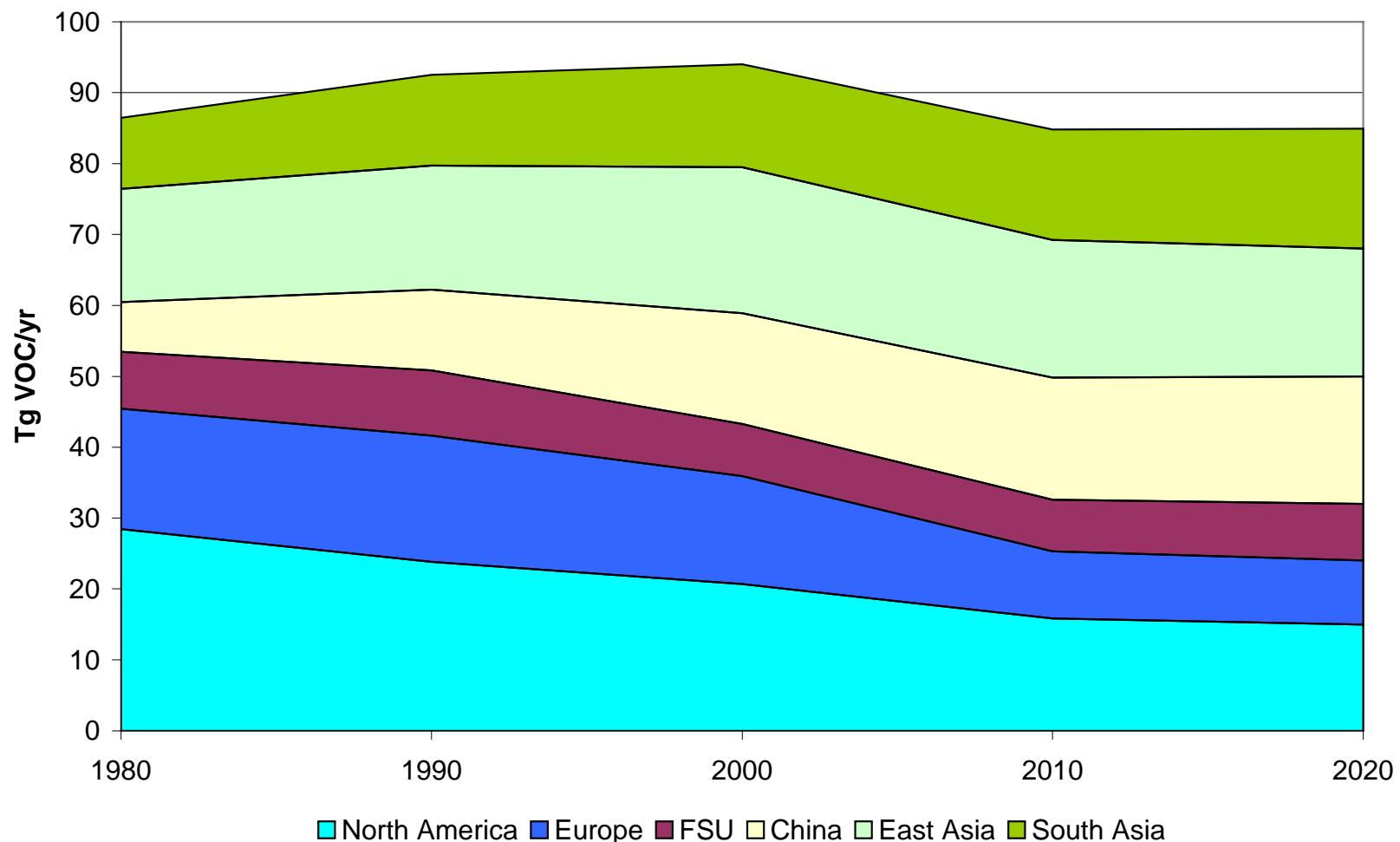
# NO<sub>x</sub> emissions 1980-2020



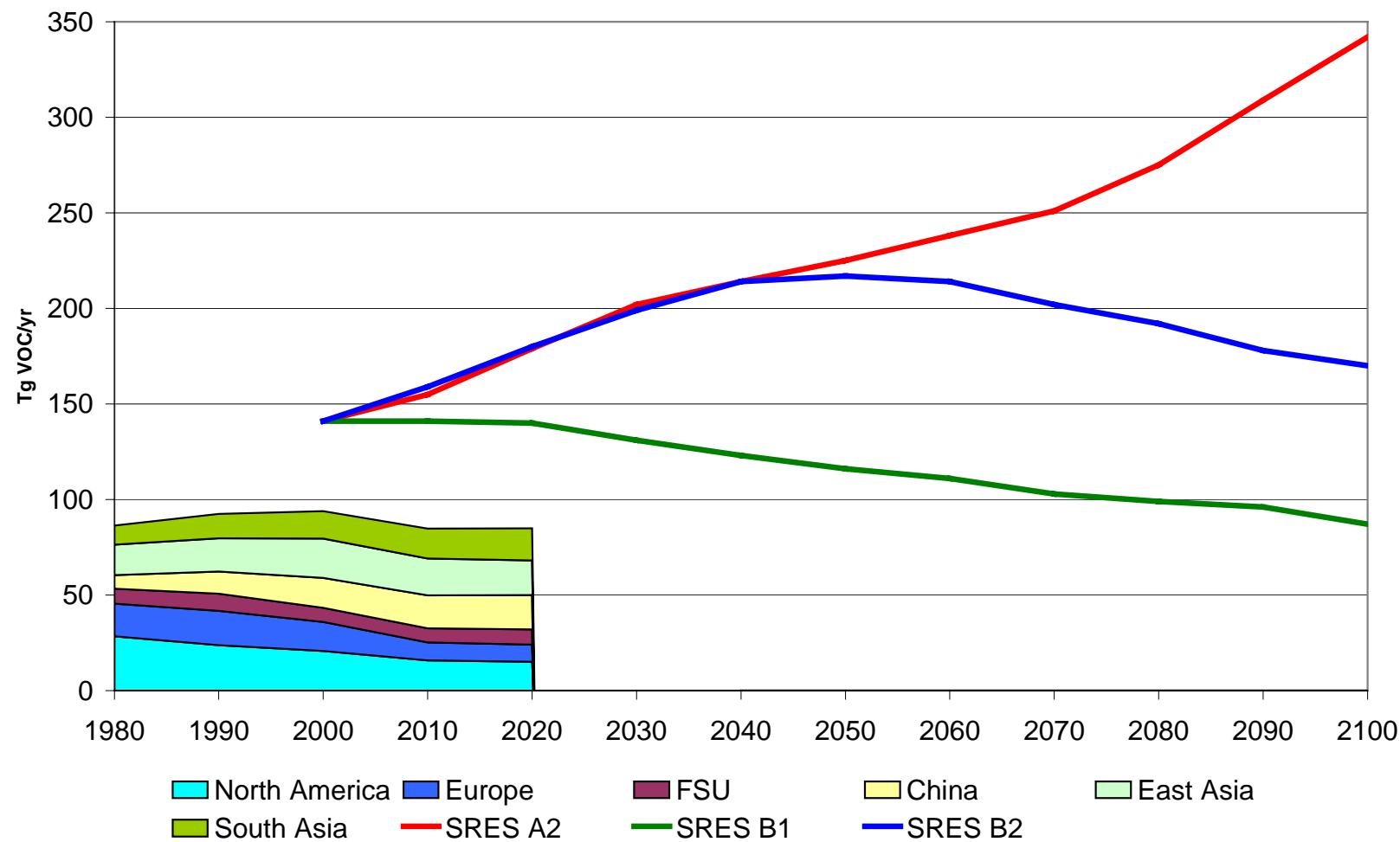
# NO<sub>x</sub> emissions in IPCC-SRES scenarios



# VOC emissions 1980-2020

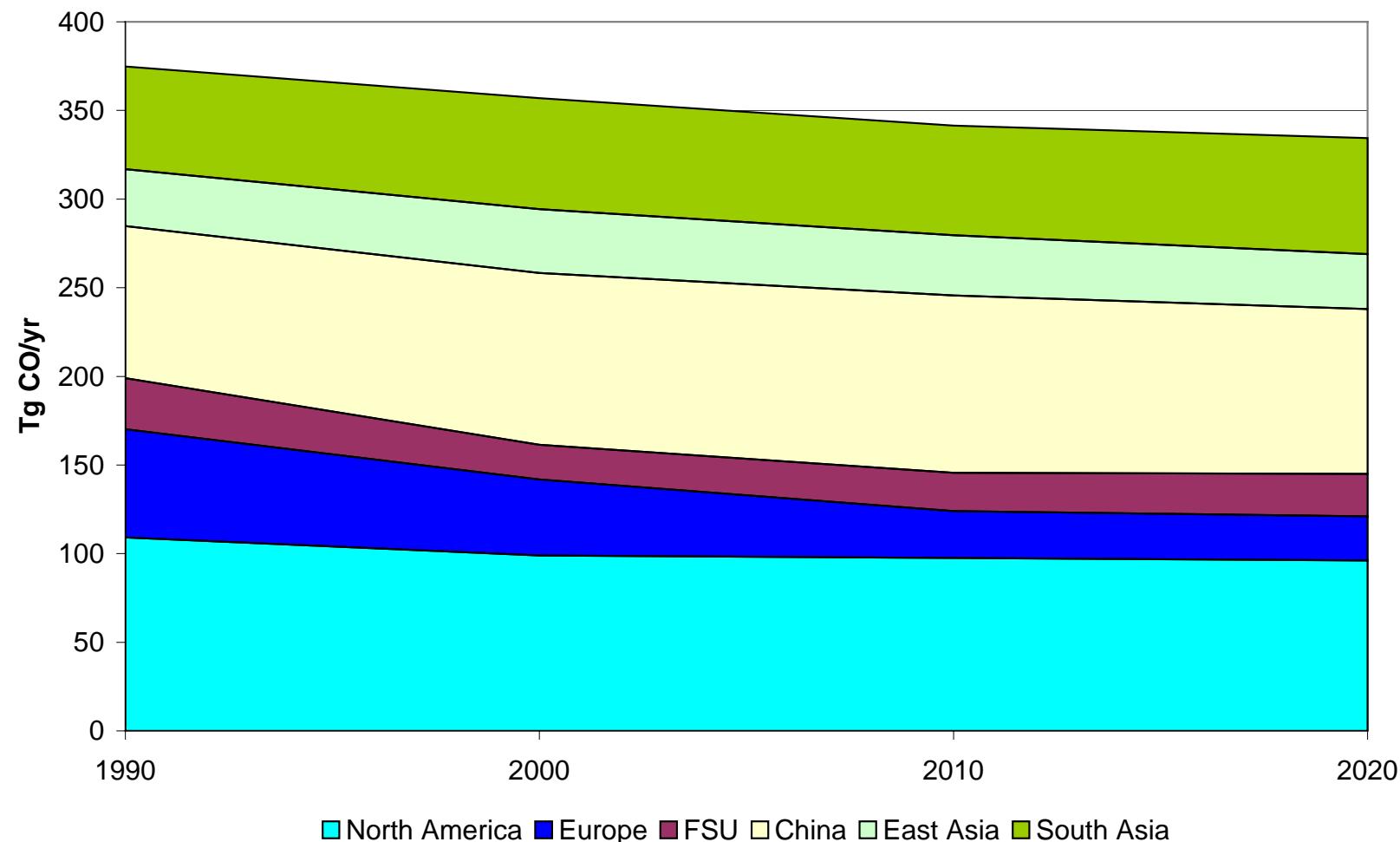


# VOC emissions in IPCC-SRES scenarios

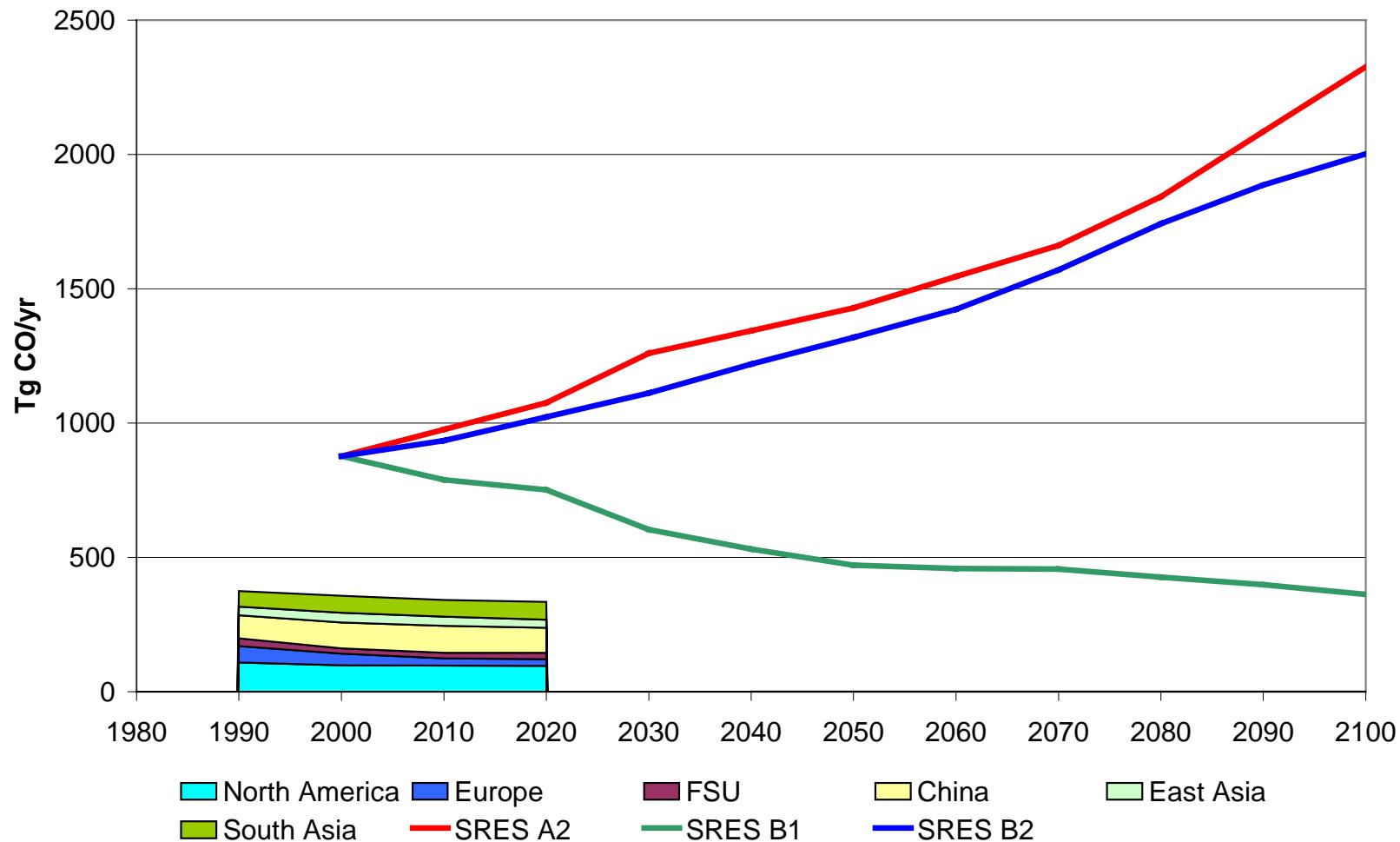


# CO emissions

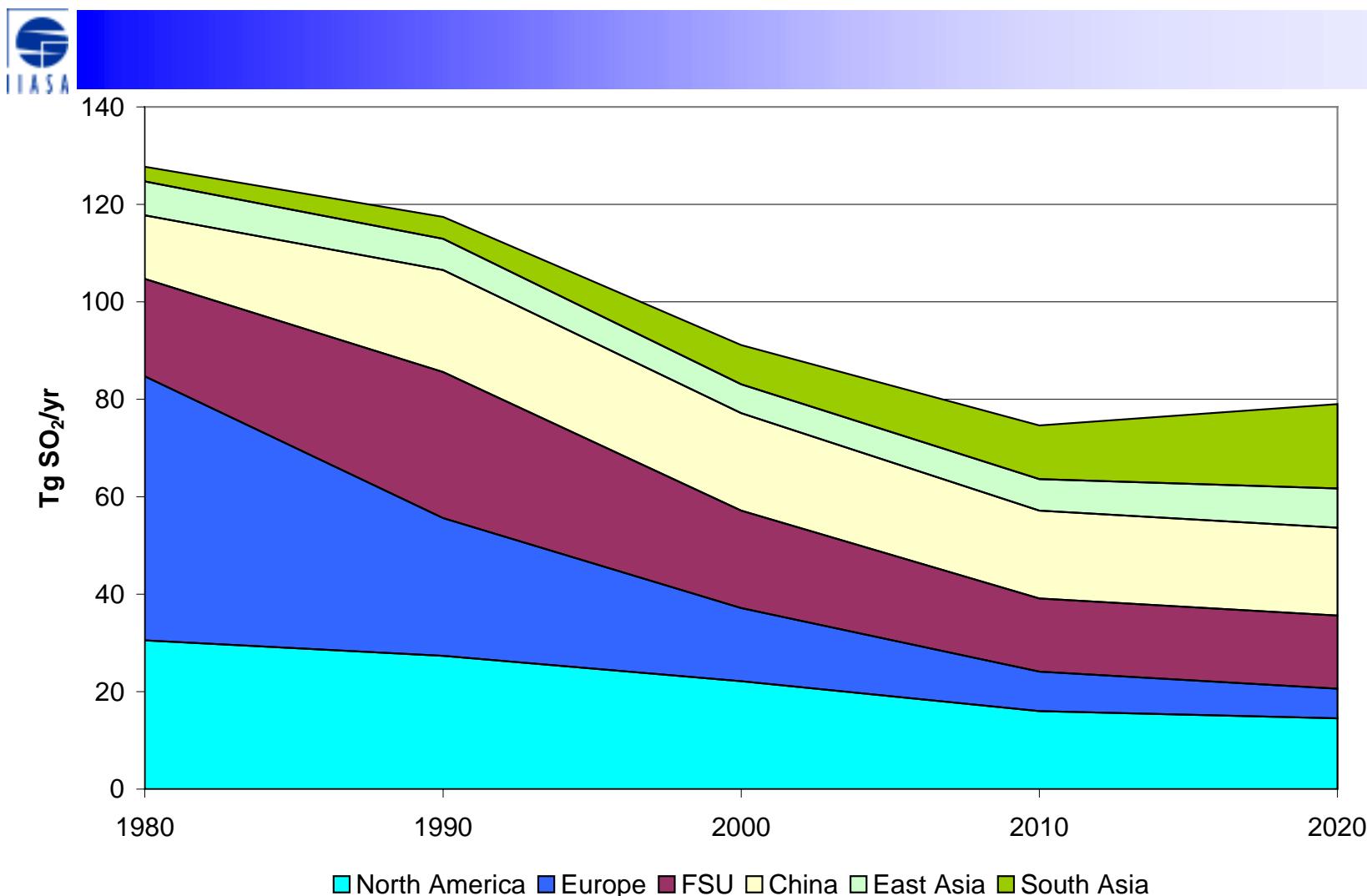
## 1990-2020



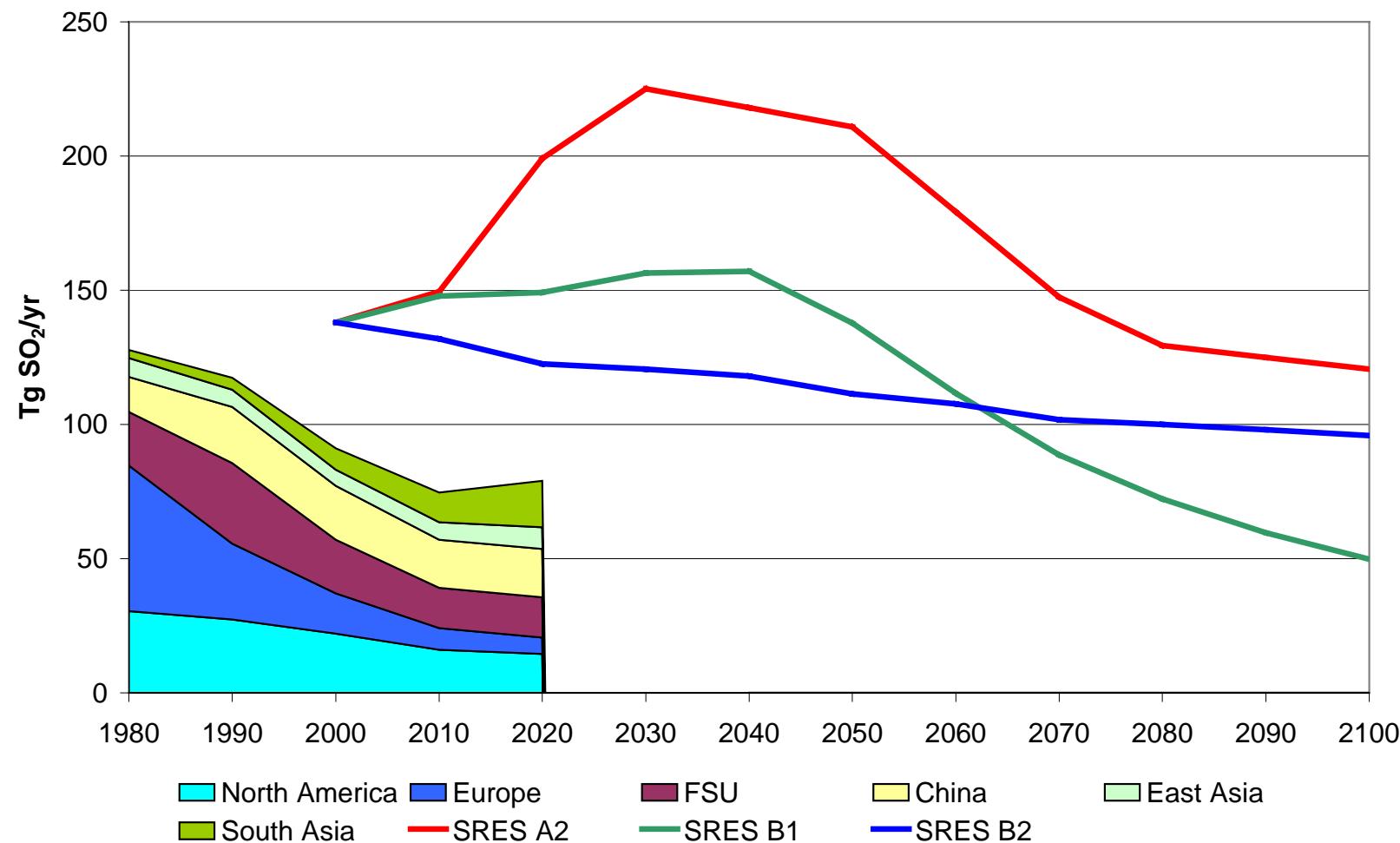
# CO<sub>2</sub> emissions in IPCC-SRES scenarios



# SO<sub>2</sub> emissions 1980-2020



# **SO<sub>2</sub> emissions in IPCC-SRES scenarios**



# Conclusions (1)



- “Classical” anthropogenic air pollutants ( $\text{NO}_x$ , CO, VOC,  $\text{SO}_2$ ) unlikely to grow in the northern hemisphere in next 20 years
- (Controlled) increase in developing countries compensated by controls in industrialized countries
- Trends diverge from assumptions made for IPCC SRES climate scenarios
- Implications for oxidizing capacity of atmosphere in climate scenarios?

## Conclusions (2)



- **But: Planned measures will not achieve “safe” air quality levels (PM, O<sub>3</sub>)**
- **In some industrialized countries limited potential for further technical emission controls:**
  - Additional potential only through structural changes induced by CO<sub>2</sub> reductions
  - Further reduction of ground-level O<sub>3</sub> through hemispheric CH<sub>4</sub> control?
- **Developing countries started to control mobile sources; but for stationary sources only SO<sub>2</sub>**